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Wound Care for Facial Burns

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WOUND CARE FOR FACIAL BURNS

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This Independent Study, submitted by Barbara E. Wilson in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

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ABSTRACT

More severely burned patients are surviving thermal burn injuries due to advances in medicine. A burn on any area of the body requires appropriate wound management. However, facial burns present with unique problems as the face is constantly exposed to society and the environment.

The purpose of this paper is to provide physical therapists with facial burn wound care and rehabilitation. Knowledgeable physical therapists are needed as members of rehabilitation teams to return facially burned patients to optimal functional and cosmetic levels.

Burn wounds are closely monitored, cleaned, and debrided to minimize infection. Skin care and patient education begins once the wound is closed and continues for the remainder of the patient's life. Burn scars are treated with pressure, splinting, exercise, and positioning to prevent deformity. Pain must be managed, and pain reduction alternatives are explored. Rehabilitation professionals must work together to provide adequate and timely psychological intervention to ensure the patient a smoother reentry into society and the work environment.

CHAPTER 1

INTRODUCTION

Twenty-five years ago, most severely burned patients had little hope of surviving their thermal burn injury. Those fortunate enough to survive the initial shock succumbed at a later date to infection.[1] With advances in medical technology, increasing numbers of burn victims are surviving. As of 1992, patients with up to 70% total body surface area (TBSA) involvement are expected to survive.[2]

Presently, each year in the United States more more than 100,000 patients,[3] or approximately 1% of the population,[4] sustain burns severe enough to require hospitalization.[5] Mortality rates average 6500 to 12,000 annually.[6]

As of 1992, there were 198 burn care treatment facilities in the United States.[4] Generally, these burn care facilities treat only one third of all burn injuries. The remaining burn injuries are treated in non-burn treatment facilities. In addition, due to cost constraints, burn patients are being discharged earlier from burn centers to local hospitals or outpatient clinics. Patients may be discharged with incomplete wound closure and incomplete psychological and social adjustment; this may result in a

serious compromise of the rehabilitation process.[4] It is therefore necessary for all physical therapists to be well informed in the special needs of burn patients.

All survivors of burns encounter potential disability, skin breakdown, pruritis, photosensitivity, depression, decreased endurance, impaired range of motion (ROM), and altered body image. These problems are exacerbated with burns to the face. Fifty percent of all thermal burns involve the face and neck.

While the aim of burn care is to save life and maximize the patient's functional and cosmetic outcome, survival does not necessitate a return to a normal life.[7] After the acute phase, patients must deal with potential deformity from contracture and hypertrophic scarring. The use of physical therapy can reduce the amount of deformity and thus eliminate the need for further reconstructive surgery.[8]

Being well informed on medical issues is not enough. Too mechanistic an approach to burn rehabilitation does not assist the patient in dealing with the psychological and social problems of reentry into the community and work environment. Facial appearance is a prime determinant in body image and social acceptance. Those with facial burns often require extensive psychological adjustments. Complete psychological recovery may take five to ten years in adults and 10 to 20 years in children.[2]

This paper is not designed to cover all aspects of burn care. This literature review will provide physical therapists with current information on proper thermal burn care and rehabilitation. Detailed descriptions of burn classifications and grafting are provided. Wound care for the prevention of infection, including hydrotherapy, debridement, antimicrobial agents, dressings, and wound assessment are addressed. Skin care information is provided for all stages of healing. Additionally, the prevention of hypertrophic scarring and contractures is discussed. And lastly, psychological and social issues are presented to insure the patient receives prompt and adequate psychological intervention and pain relief. The emphasis throughout the paper will be on the management of facial burns.

CHAPTER 2

ACUTE CONCERNS

It is not within the scope of this paper to provide a thorough discussion of acute concerns with respect to thermal burns of the face. However, it is necessary for the physical therapist to have a good understanding of the special concerns of facial burns through all stages of burn care. This chapter will focus on acute care concerns of burn classification, grafting, and donor sites.

Burn Classification

There are three types of thermal burn depths severe enough to require medical attention. These include superficial partial-thickness, deep partial-thickness, and full-thickness burns. The deeper burn depths result in slower healing with an increase in disfiguring scars.[9]

Superficial partial-thickness burns (partial second degree) damage the epidermis and upper layers of the dermis.[10-12] Structures within the dermis such as nerve endings, sebaceous glands, sweat glands, and hair follicles are not involved. This burn is characterized by erythema, pain, blisters, and edema.[10,12-14] Minimal scarring occurs due to rapid spontaneous epithelialization.[10,14] These burns heal in one to three weeks if not infected.[8,10,14] The new

epithelium is usually dry and pruritic for several weeks due to impaired sebaceous glands.

Deep partial-thickness burns (deep second degree) involve destruction of the epidermis with severe damage to the dermis.[10-12] Most structures of the dermis are damaged but viable.[10,11,13] Damage to the vascular network and capillary beds results in bleeding and increased edema at dermal-epidermal junctions.[10] Characteristics of this burn depth include pain and edema, with a red to white appearance as the depth of the burn increases.[10,13] Epithelial islands of unburned skin serve as sources for new skin growth.[10,11] Spontaneous reepithelialization generally occurs within 3 to 12 weeks depending on the individual and providing infection does not occur.[8,10,14,15] Infection of a deep partial-thickness burn can convert it to a full-thickness burn.[10,13] Scarring is common and can cause contractures and nonpliable skin surfaces.[8,16] The healed skin is thin and fragile with increased sensitivity to even minor trauma.[10] Due to the damage of the sebaceous glands, the new skin will be dry, scaly, and itchy.[10]

Full-thickness burns (third degree) destroy the epidermis, dermis, and structures within the dermis.[10-13,16] The subcutaneous fat layer is also partially damaged. Damage may extend to the underlying muscle, tendon, and bone. This severity of burn is characterized by a dry, leathery, painless wound with a white appearance.[10-13]

Spontaneous reepithelialization is not possible as there are no epithelial remnants.[10,11] Tissue regeneration will occur only at the margins of the burned area.[10] Full-thickness burns are especially vulnerable to infection due to the extent of the damage. Infection can increase the depth of a full-thickness burn to include the underlying fascia, muscle, tendon, or bone.[10] Grafting is necessary as this burn will not heal spontaneously.

Grafting

The purpose of grafting is to provide either a permanent cover for exposed tissues for protection and prevention of infection.[13] Grafting occurs following excision of necrotic tissue once the patient is hemodynamically stable and edema recedes.[1] Duncan[1] recommends grafting be completed during the first week following injury, whereas Achauer[17] and Rouge[18] feel grafting into the second or third week is acceptable without increasing the likelihood of hypertrophic scarring. Advantages of early coverage include earlier mobilization, decreased pain due to less need for repeated dressing changes, decreased hospital stay, decreased potential for invasive infections, and decreased incidence of hypertrophic scarring.[1] Disadvantages of earlier excision and grafting include exposing the patient to surgical stress in immediate postresuscitative periods, and the risk of excising viable tissue that may heal with time.[1]

Superficial partial-thickness burns generally do not require grafting as these burns will heal spontaneously if no infections occur.[8] However, deep-partial and full-thickness burns require surgical intervention of some form. Grafting is necessary to prevent further damage and decrease the likelihood of infection.[8,10,11] Smaller wounds can be excised and closed whereas larger burns require excision and coverage with a skin graft.

Possibilities for facial grafts are limited due to the anesthetic and functional value of the face. Underlying facial structures contain both rigid and soft areas as well as orifices.[19,20] Facial skin is necessarily extremely thin and extremely mobile to allow for facial expressions.[18] McIndoe[21] and Le'vignae[22] state that the aesthetic end result from a facial burn should be a delicate skin of normal color with easy movement over underlying structures and orifices, and with nondeformed free edges. They further state that a good functional result is facial skin that is mobile, allowing for a symmetrical face capable of conveying expression and of smiling.

Generally, sheet grafts of full-thickness and, less often, those of split-thickness are used for facial burns. Full-thickness grafts result in improved cosmetic results yet split-thickness grafts have better "take."[8,10] Meshed grafts are not used with facial burns except in extreme

situations as the cosmetic results achieved are unacceptable.

Full-thickness sheet grafts achieve the best results if the entire face is to be recovered. Full-thickness grafts include the epidermis and dermis but not the underlying subcutaneous fat layer. Use of this graft ensures a better cosmetic result by preventing contracture and retraction. There is less deformity and asymmetry. Full-thickness grafts "take" in about 12 days when placed on good quality granulation tissue.[18]

If there is not enough unburned donor skin available, a split-thickness sheet graft is a viable solution.[18] Split-thickness grafts consist of the epidermis but only the superficial layers of the dermis. Disadvantages of split-thickness grafts are an increase in contraction, retraction, and hypertrophic scarring as compared to full-thickness grafts.[8]

The newest form of autograph, cultured epithelium, is currently being studied in burn centers. Cultured epithelium autographs are used with extensive burns and may be necessary for facial use if there is not a large enough unburned area on the patient's body for an appropriate sheet graft. Biopsies from unburned epithelial areas are reduced to single cells and combined with growth medium in a sterile environment. After 10 to 12 days, cells are three to four layers thick. Sheets of cultured epithelial cells are

attached to a vaseline gauze backing and secured to the wound. The cultured epithelial cells will adhere to wounds with remaining dermal elements, fat, fascia, or granulation tissue. The vaseline gauze backing is removed in seven to ten days.[1] It is possible to acquire sheet autografts large enough to cover the entire adult body within 3 to 4 weeks.[23]

There are several advantages, and one disadvantage to cultured epithelium. The cultured epithelium can provide coverage to extensive burns. Since the resulting epithelium is the patient's own skin, there is no risk of rejection unless infections should occur. No live animal protein or cells are used during the processing of the grafts. Cultured epithelium is very functional, but it easily breaks down.[24]

New grafting procedures are being researched. At present, it is possible to separate cadaver dermis from epidermis and use the epithelial skin to create an artificial dermis. Still in the experimental stage is research attempting to culture an epidermis that will adhere to an artificial dermis. This research is important as patients with extensive burns can receive a stronger, total body graft coverage within a shorter period of time.[24]

Donor Sites

Donor sites for facial burns are selected based on cosmetic value. Full-thickness grafts are preferred for facial burns as they offer superior cosmetic results. These

grafts are generally harvested from an unexposed body part such as the thigh or thorax,[18] at a thickness of approximately 0.001 to 0.035 inch.[1] The thicker graft will allow for improved cosmetic result. The thinner graft is used with more extensive burns when donor sites are minimal.[1] Thinner grafts also allow for sooner reharvesting of the donor site. With proper care of a donor site, multiple grafts can be harvested from the same location. However, the quality of each graft harvested decreases as the number of grafts taken increases.[25] Harvesting an autograft creates a painful partial-thickness wound adding to the total overall burn of the patient.

CHAPTER 3

WOUND CARE/PREVENTION OF INFECTION

The primary goal of wound care is to decrease the incidence of infection until the wound either heals spontaneously or is closed via grafting. Once the burn wound occurs, the eschar does not detach from the underlying viable tissue for two to three weeks. The necrotic tissue is vulnerable to infection.[9]

Infection and Sepsis

Infections in burns generally result from Pseudomonas aeruginosa or Staphylococcus aureus bacteria.[26] Healthy humans continually coexist with bacteria without succumbing to infection due to the body's defense mechanisms. However, in the burned individual, bacteria can proliferate due to the depressed defense mechanisms of the host. Factors in determining the severity of infection depend on the age of the patient, overall health of the patient, size of the burn, and the specific infecting organism.[27] Unchecked bacterial growth can develop into bacterial colonization or septicemia, and delayed healing or death.

Bacterial colonization, or wound sepsis, is a bacterial invasion of the burned tissue with no spread to the surrounding unburned tissue. Bacterial colonization is

considered greater than 100,000 organisms per gram of tissue and requires aggressive treatment to prevent the spread of infection to the surrounding tissues.[12,13,28,29] Once bacteria migrate to the surrounding unburned tissue, invasion of intact capillaries and lymphatics occurs. Bacteria then gains access to the entire body resulting in microbial sepsis.[13] Microbial sepsis occurs when bacteria proliferates beyond the capabilities of the host's defense mechanisms.[30]

Unchecked wound sepsis can develop into septicemia which is life threatening. Infection resulting in sepsis is the single most common cause of death in patients with burn injuries.[12,13,30,31] Administering antibiotics systemically is ineffective in controlling bacteria within the wound as blood vessels at the edges of the burn wound are occluded in deep-partial and full-thickness burns.[12] However, with the advent of topical antimicrobial agents, the incidence of mortality from sepsis has greatly decreased.[13,29-31]

Wound infection causes delayed healing as grafts fail when burn wound cultures contain more than 100,000 organisms per gram of tissue.[32] Infections may also result in decreased patient activity, and potential disability.[30]

To control infection, the specific infection control procedures of the facility need be adhered to. Nonsurgical attempts to control potential infection include daily hydrotherapy with debridement, application of an

antimicrobial topical agent, dressings, and continual wound assessment.

Hydrotherapy and Debridement

Daily washing with hydrotherapy begins as soon as the patient is hemodynamically stable.[1,10] Facial burns can be soaked with wet gauze placed over the face, either separately or while the remainder on the body is immersed in a Hubbard tank.[12] Whenever wet gauze is placed over the face, the therapist must be careful not to allow the gauze to dry, creating a wet-to-dry dressing. Patients with facial burns can be given a swimming snorkel while undergoing full body immersion in the Hubbard tank.[10] Facial burns can also be cleansed by spraying the wound with water.[12]

The purposes of hydrotherapy are to cleanse the wound by removing eschar or nonhealing epithelium,[10] remove dressings,[10] increase circulation,[10,33] and facilitate exercise (if burns apply to areas other than the face). Wound cleansing is recommended once or twice daily, lasting 20 to 30 minutes.[1,8,12] Cleansing the wound prevents infection and prepares the site for surgery. The warm water, varying from 95 to 98 degrees Fahrenheit, will also aid in relaxing the patient.[12]

Electrolyte leaching may occur in larger burn wounds when using the immersion technique of hydrotherapy.[10,12] Adding salt to the water in a 0.9% concentration may

alleviate the condition. Using the shower technique of spraying water onto the facial burn will minimize leaching and avoid potential cross contamination. The patient, however, will be more susceptible to drafts resulting in heat loss.[12]

The patient is most susceptible to heat loss resulting in hypothermia following hydrotherapy. Hypothermia can be life threatening for the burn patient. Heat is lost via radiation and evaporation through the open burn wounds. Heat loss can be minimized by use of heat lamps and by increasing bed and room temperatures. Bathing only one body part at a time can also reduce the amount of heat loss. Core temperature should remain within 99.6 to 101 degrees Farenheit.[1]

Many burn centers no longer immerse patients in Hubbard tanks as this practice allows for cross contamination of separate wounds on the same patient. Instead, clean or healed wounds are bathed separately from infected areas.[1,12] An antimicrobial liquid detergent (such as chlorhexidine), or chlorine or iodine based additive (Betadine) is added to the water before the patient is immersed to prevent infection. Care must also be taken to change gloves, bath water, and gauze sponges often to prevent cross contamination during debridement.[1,12]

Debridement is the removal of loose, necrotic tissue and foreign material from the wound bed to prevent infection

and enhance wound healing.[1] Bullae, which are fluid filled blisters, should also be removed as they may rupture and contaminate the surrounding tissues.[34] Overly aggressive debridement should be avoided as it can cause excessive bleeding and destruction of developing capillary buds and epithelial tissue. Debridement generally occurs during bathing or hydrotherapy, during dressing changes, or during surgery. There are two types of debridement used with facial burns: mechanical and surgical.[1]

Mechanical debridement involves using gauze sponges, scissors, or forceps to remove the bullae, necrotic tissue, or foreign material from the wound bed. Coarse gauze may be used to create a wet-to-dry dressing. Moist gauze is applied to the wound in several layers. Upon drying, the inner layer adheres to the wound and to the wound debris. When the dressing is removed, the wound will be debrided. It is recommended that the gauze be removed at a 90 degree angle to maximize the amount of debridement. Care must be taken not to damage newly formed epithelial tissue. Mechanical debridement is extremely painful making premedication prior to and during the debridement necessary.[1,12]

Wet-to-wet dressings are a form of mechanical debridement using coarse gauze once granulation tissue has formed.[1,12] This type of dressing will protect the granulation tissue from trauma while still providing

debridement. Wet course gauze is applied to the wound but not allowed to dry. Wet-to-wet dressings should be removed at a 180 degree angle, gently lifting from the edges toward the center, to prevent tearing of newly formed tissue.[35]

Surgical debridement involves shaving necrotic tissue until viable tissue with a good blood supply is reached.[1] For partial-thickness burns, a knife or dermatome is used.[36] Full-thickness burns, however, require use of a scalpel or electrocautery to reach viable tissue at the subcutaneous fat or fascia level. Surgical excision is utilized when edema has receded but before infection occurs.[1] In patients with large TBSA involvement, the entire burn is not excised at one time due to surgical stress, bleeding, and lack of available donor sites.[12] Duncan[1] recommends limiting surgical excision to 20% of TBSA or two hours of surgery. Surgical debridement is followed by grafting.

Antimicrobial Agents

Mechanical debridement is utilized to prepare the site for grafting or to cleanse the wound to prevent infection. Mechanical debridement is generally followed by topical antimicrobial agents and dressings. Topical antimicrobial agents are applied to the burn wound to reduce bacterial growth. These topical agents function in reducing, not eliminating, the amount of bacteria present in the wound. They assist the body's defense mechanisms in controlling for infection.[12,13]

The three topical antimicrobial agents most commonly used in the United States are silver sulfadiazine (silvadene), mafenide acetate (sulfamylon), and silver nitrate.[12,37] Less commonly used antimicrobials against bacteria and/or fungi are nitrofurazone,[10,31] bacitracin, neosporin, nystatin, providone-iodine, Dakin's solution, and Bactroban.[31]

Silver sulfadiazine (silvadene) is a thin, white, water soluble cream which is the most widely used topical antimicrobial agent.[8,13,31] Silver sulfadiazine can either be applied directly to the wounds or to the dressings.[1] It is painless on application,[1,12] has a soothing effect,[29,38] is easier to remove than mafenide acetate,[13] and provides a broad spectrum of antimicrobial coverage against gram positive and gram negative bacteria.[1,12,13] It is recommended for use with most microbial pathogens. However, it must be used with caution if the patient has impaired renal or hepatic functions.[1] A disadvantage of silver sulfadiazine is that it inactivates rapidly[37] and does not penetrate the eschar easily.[13] It is therefore less effective than mafenide acetate against high intraeschar bacterial densities.[1,29] Silver sulfadiazine may cause a delayed eschar separation due to the adherence of the eschar.[10] This medication has one effect; there is a high occurrence of leukopenia generally occurring 24 to 72 hours after application.[37,38]

Mafenide acetate (sulfamylon) is a thick, white, water soluble cream effective in controlling bacteria. Mafenide acetate is applied directly to the wound.[1] It is capable of penetrating thick eschar and is not inactivated by wound exudate. It is capable of eliminating subeschar bacterial proliferation.[1,12,29] It is effective against most gram positive and gram negative pathogens,[1,10,12,13] and is the agent of choice with ear and electrical burns.[1] However, mafenide acetate is often painful on application;[12] patients with partial-thickness burns complain of a burning pain lasting 20 to 60 minutes.[1,13,29] Therefore, more wound care time is required by the caregiver. Side effects include metabolic acidosis secondary to carbonic anhydrase inhibition, impaired pulmonary elimination of carbon dioxide,[36] and hyponatremia.[29,38]

Silver nitrate is used in 0.5% solution and is indicated for patients sensitive to sulfa drugs.[1] Dressings are saturated with silver nitrate solution and applied directly to the wound after cleansing.[1,12,13] Silver nitrate has no pain with application and is effective against a broad spectrum of bacteria, including most common pathogens and candidal infections.[12,13,37] However, this agent must be used before the bacterial organisms proliferate as it inactivates quickly and penetrates the eschar minimally[10] or not at all.[1,12,13,37] Therefore, silver nitrate is not recommended with full-thickness burns.[10] A further

disadvantage of this agent is that it turns the eschar black, thus making wound assessment difficult.[13,37] However, it is recommended for patients with allergies to sulfa and those with toxic epidermal necrolysis.[1] Side effects of silver nitrate include electrolyte abnormalities, and possible hyponatremia and hypochloremia.[1,29]

Numerous burn centers as well as the US Army Institute of Surgical Research recommend treating burns prone to infection and those consisting of more than 20% TBSA with alternating applications of topical antimicrobials.[1,17,31] Alternating the topical agents avoids the production of resistant microorganisms while limiting the side effects of each.[1] Most commonly, silver sulfadiazine and mafenide acetate are altered every 12 hours. Silver sulfadiazine is used initially when counts are high; mafenide acetate is begun when the bacteria within the wound reach amounts greater than 100,000 organisms per gram of tissue. Mafenide acetate is more successful with prevention of wound sepsis.[29] The US Army Institute of Surgical Research further recommends silver sulfadiazine be applied in the evening to allow sleep. Mafenide acetate can inhibit sleep due to the painful side effects experienced by some patients upon application.

Antimicrobial agents may be used in conjunction with antifungal creams. A common practice is to use nystatin powder with an antibacterial cream in a 1:1 cream mixture.

Both antibacterial and antifungal agents are used full strength to provide more inclusive protection against infection.[31]

As stated earlier, silver sulfadiazine is the most commonly used antimicrobial topical agent. Before determining the choice of agent utilized, however, several burn units test their patients for susceptibility to silver sulfadiazine and the less commonly used topical agents. Even though real differences in morbidity and mortality due to the choice of antimicrobial agent have yet to be proven, unwarranted side effects and reactions may be avoided.[31]

Dressings

Antimicrobial agents are applied once or twice daily to the wound via either the exposure or occlusive method.[1,12,19] The exposure or open method involves applying either silver sulfadiazine or mafenide acetate cream with a sterile glove at a recommended thickness of approximately 1/16th inch. The wound is then left open to breathe. Advantages of this method include the lack of bulky dressings limiting ROM, elimination of painful dressing changes,[1,12,13] and continuous wound assessment.[1,10,12,13] Furthermore, bacterial proliferation will be minimized due to the lack of dressings which provide a warm, moist environment conductive for bacterial growth.[36] Disadvantages of the open method include the need for strict isolation,[1] patient complaints of being cold,[12,39] and delayed eschar separation.[39]

The occlusive, sterile, or closed method involves applying the topical antimicrobial agent to the wound and covering the wound with fine mesh gauze and cotton padding.[1,10,12,13,31] The fine gauze is itself covered with a cotton padding such as Kerlix or Kling.[10] Advantages of dressings include less heat loss, faster eschar separation, and an isolation barrier against spread of the infection. Disadvantages include increased patient discomfort due to necessary dressing changes, increased staff time to change the dressings,[1,13] decreased and more painful ROM,[1,12,13] and inability to observe the wound.[1,13]

Wound Assessment

Wound assessment is ongoing. The appearance and odor of the wound can easily be assessed daily,[10,19] as can the depth, size, granulation, and exudate.[10] Signs of infection according to O'Sullivan and Schmitz[10] include fever, rapid separation of the eschar, a thick purulent discharge, discoloration of a brownish-black nature, boils in the surrounding tissue, and the conversion of partial-thickness burns into full-thickness damage. The majority of burn care centers in the United States also monitor wounds for microflora on a daily or twice weekly basis.[1,31] Surface swabs and biopsy are used for quantitative assessment of the microflora and fungi present. Histopathology is occasionally used to distinguish the presence of invasive wound sepsis.[31] However, due to the expense and time

consumption of histopathology testing, few burn centers consider this practical on a routine basis.[31]

CHAPTER 4

SKIN CARE

Skin care begins once the burn wounds have been successfully grafted and continues throughout the remainder of the patient's life.[15] The type of skin problem occurring depends on the depth of the burn wound and the type of graft used. Both grafted and ungrafted skin may blister and breakdown. Newly formed skin has abnormal lubrication, which may result in prolonged itching, or pruritis. Xerosis, or skin dryness, may lead to severe pruritis. Irritant and/or allergic contact dermatitis may occur due to an intolerance to the ointment or topical agent used. Sensitivity to sun exposure may result in sunburn. This chapter will address blistering, xerosis, pruritis, irritant and allergic contact dermatitis, and photosensitivity in the healing burn patient.

Blisters

Blisters commonly occur on burn wounds covered by spontaneous reepithelialization or grafts.[7,15] The blisters on spontaneously reepithelialized skin (the burn wound or the donor site) are generally limited to the sub-epidermal layer. Split-thickness or cultured epithelium grafted skin

may acquire blisters at the sub-lamina densa which may last up to 9 months.[15]

Blisters tend to occur two to six weeks after the wound has closed and are generally less than one centimeter in diameter.[40] The blisters gradually diminish as the wound heals but the tendency to blister may last several months.[41]

Although it is not necessary to drain small blisters that are intact, those which are uncomfortable or interfere with treatment may be aspirated with a sterile needle. The blister roof is left in place,[7,15] and the blister is allowed to dry without debridement.[7] Large blisters require careful monitoring and treatment to prevent infection and thus enlargement of the wound.[7] Dried blisters or noninflamed crusts are easily removed with mild soap and water after which an antibiotic ointment is applied. Poh-Fitzpatrick[15] recommends bacitracin, polymyxin-bacitracin, or mupirocin. Purulent blisters can be softened with wet compresses saturated with tap water, saline solution, or aluminum acetate. Once softened, these blisters can be gently removed and an antibiotic ointment applied. Whenever blistering occurs adhesive dressings are not recommended.[15]

Xerosis

Ordinarily, skin is lubricated by lipids of epidermal cell origin and lipids secreted from sebaceous glands. Normal lubrication from epidermal cells is not possible until a granular cell layer differentiates and begins normal

function. A lipid reservoir of sufficient thickness and organization to prevent dehydration must also accumulate within a stratum corneum.

The burn depth affects lubrication from sebaceous glands. Superficial burns may retain enough sebaceous glands to eventually provide adequate lubrication. Full-thickness burns covered by split-thickness or cultured epithelium grafts will not regain full function of the sebaceous glands, and must therefore rely on lipids from the epidermal cells only. As the dorsal and planter surfaces of feet and palms of hands do not normally contain sebaceous glands, it is not known whether sebum is necessary for maintenance of healthy skin.[15]

Healed wounds should be covered with mild lotions to prevent xerosis and splitting of the newly formed skin.[15,40] Lanolin lotions or creams, cocoa butter, or aloe vera cream are recommended as each contains water to hydrate the stratum corneum and lipid to prevent evaporation.[40,41] Lotions with nonessential fragrances and exotic plant oils or extracts should be avoided as they may cause irritation or contact sensitization. Finally, dehydration can be reduced by the addition of a room humidifier.[15]

Pruritis

Even survivors of modest burns experience prolonged and perhaps severe pruritis.[15,42] Pruritis, or itching leads to scratching. Fowler[43] suggests that continued scratching may

result in thickened scar tissue. Unfortunately, the pathophysiology of pruritis or severe itching is poorly understood.

Severe itching is most often treated with systemic antihistamines.[15,44] Antihistamines are currently available from five different chemical families including ethanolamines, ethylenediamines, piperazines, alkylamines, and phenothiazines. The three most common antihistamines prescribed for severe itching are Benadryl, (Parke-Davis, Morris Plains, NJ) an ethanolamine; Atarax, (Roerig Division of Pfizer Inc., New York, NY) a piperazine; and Polyhist Forte, (Mikart Inc., Atlanta, GA) a multiagent with ethylenediamine and alcole-amine components.[44]

The exact mechanism by which antihistamines relieve itching is not known. It is thought that sedation of the individual, which is a side effect of all antihistamines, may be the reason for the drugs' effectiveness.[45,46] And since patients respond to each antihistamine differently, failure of one antihistamine does not necessitate failure of another.[45] Generally, systemic antihistamines achieve disappointing results, especially with severe itching.[15,44] The majority of patients receive no relief at all with systemic antihistamines and only a minority receive partial relief.[44]

If xerosis is contributing to pruritis, relief may be obtained with the application of a skin emollient.[15,44]

Topical lubricants such as cocoa butter, Nivea lotion (Beiersdorf, Inc., Norwalk, CT) or baby oil may be used to prevent skin dryness and thus prevent itching.[44] Poh-Fitzpatrick[15] recommends an emollient with menthol (1/4% to 1/2%) and camphor (1/2% - 2%); it will feel cool and temporarily relieve itching and dryness. Greater relief can be achieved by the application of a lotion which has been refrigerated. Pramoxine hydrochloride 1%, an anesthetic available in ointment, cream, or lotion form, may give temporary relief of pruritis. Topical benzocaine ointments should not be used due to the allergic reactions produced in many patients.

Vitale[44] states that the severity of itching is not related to age, or whether or not the wound was surgically excised. Rather, itching severity is related to the amount of TBSA burned and the amount of time required for wound closure. In general, wounds taking more than three weeks to close and patients with more than 40% TBSA involvement are more likely to require medication for severe itching. The anatomical area of the body burned also affects the severity of itching. Burns to the face are the least likely area to be affected by pruritis.

Irritant and Allergic Contact Dermatitis

Newly formed skin is susceptible to irritant and allergic contact dermatitis. Eczema may result. Irritant dermatitis is a reaction to chemicals found in lotions,

soaps, or solvents. Allergic contact dermatitis may also occur with use of these products.[15]

Allergic contact dermatitis is a delayed hypersensitivity and requires a latent period of at least five or 6 days between exposures to the causative substance.[47] Epidermal Langerhans cells process antigens which are presented to epidermal T-Lymphocytes. T-Lymphocytes attack the substance, resulting in sensitization.[15,47] Few Langerhans cells are found in split-thickness grafts for the first few weeks following grafting. Cultured epithelium grafts produce Langerhans cells within the first week. Generally, normal amounts of Langerhans cells are seen in all grafts within 2 to 12 months. However, after one year the amount of Langerhans cells in burned skin increases two to five times those normally found in intact skin. The increase in number of cells is thought to increase skin tolerance to allergens.[15]

If either irritant or contact dermatitis is found, all lotions, soaps, creams, and topical agents must be discontinued. The area should be washed with plain water followed by an application of a different agent which has not been previously used with this patient. It irritation and inflammation is severe, topical corticosteroids may be used sparingly and for only a few days.[15]

Photosensitivity

Burn wounds are sensitive to ultraviolet (UV) light. The ultraviolet B wavelengths (UVB), the erythemal range of UV light present in sunlight, is from 290 to 320 nanometers. The majority of UVB energy normally absorbed by the dermis depends upon the thickness of the stratum corneum, the degree of melanization, and the production of urocanic acid. Ultraviolet A (UVA) wavelength energy, 320 to 400 nanometers, produces less erythema but penetrates deeper into the layers of the skin and causes potentially more damage to structural and matrix proteins. This damage is referred to as solar degeneration.[15]

The return of melanocytes is generally delayed from two weeks to seven months in patients receiving cultured epithelium grafts. Split-thickness grafts require even longer for melanocyte return, with the return taking several weeks to three years.[48] It is therefore necessary for patients to avoid direct sunlight for a minimum of six months to several years after their burn wounds have healed. This is especially important for patients with facial burns. Early or prolonged exposure to direct sunlight may result in sunburn and permanent hyperpigmentation.[15] Patients can protect themselves from sunlight by wearing hats and appropriate protective clothing. Appropriate timing of outdoor activities can also prevent overexposure. The use of sunscreens is recommended. A Sun Protection Factor (SPF)

of at least 15 for both UVA and UVB is desirable. Facial sunscreens with higher SPF are available for longer exposures to sunlight. Sunscreens in lotion or cream form are preferred as they add moisture to the skin.[15]

Skin care begins as soon as the burn wound heals and continues for the remainder of the patient's life. It is necessary for the patient to be well educated in appropriate skin care to prevent further complications such as malignant degeneration.

CHAPTER 5

FACIAL FUNCTION: MOBILITY AND FREE MOVEMENT

Cosmetic and functional disfigurements are common results of facial burns. Cosmetic deformities result in decreased self esteem since the facially burned patient has to confront the gaze of others in daily life.[18] Functional deformities result in decreased range of motion (ROM), and difficult swallowing and articulation.[49,50]

Facial deformities are caused from contracture and hypertrophic scarring. Contraction occurs as epithelialization attempts to constrain the wound.[8] Infections and certain medications disrupt normal healing resulting in excessive repair and hypertrophic scarring.[51] Hypertrophic scarring is an excessive amount of dermal components such as collagen, cells, and vascular components.[52] Keloids are hypertrophic scarring passing beyond the normal boundaries of a wound. The prevention of contractures and hypertrophic scarring, and therefore deformities, is the most difficult aspect of burn rehabilitation.

For optimal prevention of contractures and hypertrophic scarring, the patient and the family need to be active participants in all aspects of treatment. Treatment

includes education, appropriate reinforcement, and emotional support. Treatment goals are compliance, cosmesis, function, and psychological adjustment.[43]

This chapter will present options for control of facial hypertrophic scarring and contractures. Deformities can be controlled but not prevented by correct positioning, pressure therapy, splinting, and exercise.[7,13,52]

Positioning

Correct positioning to prevent contractures should begin within 24 hours of burn injury.[4,10,43] Early positioning decreases contracture formation by counteracting the pull of the myofibroblasts.[53] Early positioning decreases edema which can delay and complicate wound closures.[43] Deformities may be decreased.

Burns to the face alone do not require specific positioning guidelines. Patients with burns to the ears are positioned without pillows to prevent further injury.[12,54] If the patient has anterior or circumferential neck burns she or he should be positioned supine with the head in hyperextension and neutral rotation.[8,10,54,55] Alternative supine positioning involves placement of a square towel in the mid back from T1 toward the lumbar spine as low as is tolerated. The towel should be narrow to allow for shoulder retraction.[13] Until the scar becomes mature the patient should never have a pillow beneath her or his head.[12,13,54,55]

Pressure Therapy

Pressure therapy came into use in 1971 and is still the method of choice for control of scar formation.[56,57] Early pressure on healed or grafted skin reduces hypertrophic scarring and positively influences scar maturation.[43] The goal of pressure therapy is a flat, pliable scar which is cosmetically acceptable and does not restrict function.[7]

While the exact mechanism of pressure therapy is unknown, even pressure realigns collagen bundles, reduces vascularity, and produces a related ischemia in the scar thus retarding collagen synthesis.[52] Judge et al[55] state that low pressure (5-10 mmHg) is inadequate to control scarring, yet high pressure (20-30 mmHg) causes distal edema and is abrasive on newly healing grafts; the authors recommend using 10-20 mmHg pressure. Other authors recommend 20-30 mmHg pressure as this is at the arterial capillary level.[4,12,50,52,57,59] The majority of burn units attempt a pressure of 25 mmHg, although actual pressures obtained may be between 5-15 mmHg and still achieve satisfactory results in some patients.[59] Facial concave areas receive no pressure and areas with large radii of curvature receive low degrees of pressure.[59] Extra padding under garments is therefore necessary to counter these findings. Cheng et al[59] state that 5-15 mmHg pressure will achieve satisfactory results in some patients; pressures between 35-40 mmHg will result in a more rapid maturation of

hypertrophic scars thus decreasing wearing time of the pressure garments.

Not every facial burn results in scarring. Factors contributing to hypertrophic scarring include patient's age, skin characteristics, anatomical location, graft type, burn depth, and length of healing time.[4] Children of any age group are the most likely to scar.[8] Very fair and black individuals are at an increased risk of scarring.[60] The face and neck, along with the hand and axilla, are the most likely areas for hypertrophic scarring to occur.[60] The type of graft affects hypertrophic scar development. Split-thickness grafts scar more readily than full-thickness.[61] Skin grafts placed on tangentially excised wounds scar less often than grafts placed on granulation tissue.[61]

As mentioned previously, burn depth and healing time affect the development of hypertrophic scars and contractures. Superficial burns will spontaneously heal with minimal scarring.[4] Deitch[62] established the following guidelines for use of pressure with deep-partial and full-thickness burns: 1) for wounds healing spontaneously in less than ten days no prophylactic pressure is required 2) for wounds taking longer than 10 to 14 days to heal, prophylactic pressure is recommended for black patients only 3) for wounds taking 14 to 21 days to heal, prophylactic pressure is recommended for patients of all ages and races 4) for wounds taking longer than 21 days to heal,

prophylactic pressure is mandatory. Nongrafted deep partial-thickness or grafted full-thickness wounds generally are open a minimum of 21 days; thus mandatory pressure therapy is required.[4] Helm[4] reports that if a healed burn loses its redness within two to three months it won't hypertrophy.

Controlling hypertrophic scarring via pressure therapy depends on the age of the patient,[4] stage of healing,[7,11] the depth and anatomic location of the facial burn,[4] type of graft used,[4] choice of pressure garment, proper measurement techniques,[59,63] and therapist's and patient's preference. Pressure garments are generally not applied until the wound is closed since the newly formed skin is too fragile. However, Johnson[52] uses pressure garments if scattered open areas are interspersed with healed areas. The pressure garment should facilitate topical medications. Fine mesh gauze or nonadherent dressing is placed between the open areas and the pressure garment to protect the newly forming tissue. The area is watched closely to ensure the pressure garment is not damaging the open areas. If so, the pressure therapy is discontinued.

Early pressure therapy involves minimizing edema. Fluid under the graft may be eliminated by aspiration with a small syringe or with a technique called rolling. Rolling involves cutting a small hole in the graft near the bleb and gently easing the fluid out with cotton tipped applicators.[1]

Pressure to very small open wounds can be obtained with the use of dry gauze such as Telfa (Kendall Co., Boston, MA) or gauze impregnated with Vaseline (Sherwood Medical, St. Louis, MO).

Use of a custom facial pressure garment begins once the burn wounds are closed and the healed or grafted skin is mature enough to tolerate constant pressure and friction.[7,11] If use of the garment begins too early, skin breakdown can occur.[7,52] The masks are worn until less than 10% of the wound is abnormal in reference to color or surface projection.[64] Custom pressure face masks can be either elastic or plastic.

The elastic custom face mask allows for a variation in design and pressure to fit the needs of the individual patient.[50] The mask design is dictated by the location of the burn margins.[65] The mask is recommended to extend 2 inches beyond the burn margin to achieve optimal pressure.[7] Accurate fit is imperative; weight gain or loss and children's growth spurts can necessitate purchasing a new garment.[52] As the patient wears the garment for 23 hours per day, owning two garments is necessary; one is worn while the other is laundered.[52,59,66] Recommended usage is for 12 hour periods to minimize the time-dependent drop in pressure of the garment due to the stretch of the elastic fibers.[59]

The amount of pressure applied can be increased by using gradient pressure burn garments such as Jobskin and

Bio-Concepts.[50] Manufacturers are available to assist with fabricating inserts or supports to prevent bridging of fabric over anatomical prominences.[8,52] Elastic face masks are manufactured in the United States by Jobst Institute, Inc. (Toledo, OH), Bio-Concepts, Inc. (Phoenix, AZ), Barton-Carey Medical Products (Perrysburg, OH), and Gottfried Medical, Inc. (Toledo, OH).[8,50] Each manufacturer has their own measuring systems and special rulers which they provide at no cost. Videos and training classes are also offered at no cost.[50,59]

Disadvantages of the elastic face mask are many. The Lycra in the fabric deteriorates and stretches requiring regular garment adjustment and replacement to maintain adequate pressure.[4,52,59] Replacing both garments each month is recommended as the viscoelastic properties in the garment decrease by 50% within the first four weeks of use.[59] Numerous follow up appointments are necessary to assess whether or not the garment is providing sufficient pressure.[59] The abrasive fabric may cause blistering, ulceration, and edema in areas where adequate pressure has been achieved.[11,59,67] Many patients experience an allergic reaction to the fabric resulting in weeping, open wounds.[4]

There are additional disadvantages. The face mask occludes the face, it is noticeable and not attractive. Wearing a face mask embarrasses many patients, decreases their self-esteem,[52] and encourages the patient to withdraw

from society.[12] Patients may complain of increased heat and discomfort from use of the pressure garment;[11,12,52] patient complaints decrease and compliance increases if an elasticized cotton (versus nylon) garment is used.[64,68] Irregular contours of the face are difficult to apply adequate pressure to since the fabric bridges over concave areas. Areas around the nose and eyes will need inserts.[52]

Due to the uneven contours of the face, uneven pressure is to be expected. The use of rigid or semi-rigid inserts will augment the pressure.[7,8,52,63,69-71] Inserts can be composed of various materials to ensure adequate pressure.[7,52] and to stabilize the nose and central portions of the face.[66] Foam rubber inserts may be necessary over open wound sites to prevent skin breakdown.[7] Materials are selected based on their ability to mold and their flexibility, texture, and compressibility.[52] Alston et al[72] recommend Polycushion, Betapile, silicone elastomer, and thermoplastics such as Polyform. Each product has advantages and disadvantages. For example, Betapile is soft, nonabrasive, and compressible; but due to it's compressible nature it fails to maintain consistent pressure. Silicone elastomer is a catalyzed liquid that conforms well to anatomical areas by hardening to a rubbery consistency. Although the method of application is simple, many patients experience sweating and maceration of the underlying skin.[52] Inserts should be

attached with velcro and not sewn into the garment. Velcro allows for adjustments as the edema shifts and recedes.[67]

Burn patients complain of restricted mobility following use of elastic garments.[52,73] However, Ward et al[73] failed to find a significant predictable decrease in ROM following elastic mask usage. It is suggested that there are initial measurable affects on ROM produced by this mask along with patient perception of decreased ROM. However, these are not long term detrimental affects.

Leung et al[67] researched the effect of prolonged pressure garment use on skeletal growth. Results showed mandible growth was retarded by use of pressure[4,67] resulting in recession of the chin, malocclusion of the teeth, and arthritis of the temporolmandibular joint (TMJ).[67] It is not known at this time if the skeletal retardation is reversible. Leung et al[67] recommend that pressure garments be worn no longer than 12 hours per day in conjunction with alternative treatment such as steroid injections. Manufacturers and burn centers recommend a wear time of 20 to 23 hours per day.[50,52] Further investigation is necessary.

The plastic or transparent face mask, also known as the rigid or semi-rigid face mask, is made of clear cellulose acetate butyrate.[63] Continuous assessment of the scarred area is possible allowing the caregiver to see the amount of blanching provided by the mask.[12,43,63] Precise molding provides constant uniform pressure over facial contours

eliminating the need for inserts.[7,63,70,71] The mask is attached by straps around the head which can be adjusted to alter the amount of pressure.[12,63] Replacements of the mask are needed only if the patient's head has grown or if the mask has been modified beyond repair with reheatings and filings.[63] The plastic face mask can easily be used in conjunction with microstomial devices. It is recommended that the mask be worn a minimum of 20 hours per day, removed only for a maximum of one hour durations for exercising, eating, and hygiene.[63]

Use of the clear plastic face mask has a positive influence on the patient as the face is visible. This mask allows for increased self-esteem and acceptance of the facial burn by the patient.[43] Wearing the plastic mask may be functionally beneficial in returning the patient to work and social activities. Society is more tolerant of the plastic face mask as the face is visible and the person is recognizable.[12]

Disadvantages of the plastic mask include the cost of molding, time in manufacturing, and the need for regular adjustments.[43] In addition, very young or elderly patients may need to be anesthetized during the manufacturing of the mask.[12,63,74] The mask may be molded during surgical debridement although the face may be distorted due to endotracheal intubation.[12,63,74] To prevent distortion of the face, anesthesia may be provided via a ketamine anesthetic

technique; the airway is unprotected, however, and aspiration of gastric contents, laryngospasm, and apnea may result.[74] Layon[74] recommends using a halothane anesthesia with a nasotracheal tube to minimize the airway risks.

Patients complain of heat and sweating when wearing the mask.[43,70,71] The mask is rigid, and there is an interruption of the continuous pressure when the patient talks, eats, or expresses emotion. Rigidity does not accommodate to shifting edema, resulting in subsequent changes in pressure. Weekly monitoring sessions are recommended; these may be difficult if the patient lives a distance from the facility.[12] Finally, normal dynamic movement of facial muscles is prevented.[43]

The therapist's choice of pressure garment depends on the anatomical location of the burn (burn on bony prominence, cheeks, mouth), age of patient (general anesthesia is necessary for specific types of rigid masks), and personal preference or dictates of the burn unit.[75] Gallagher[75] conducted a survey in 1990 of 97 burn units in United States and Canada to determine, among other items, which type of facial pressure mask was most commonly used. Results showed that 87 burn units used elastic face masks. Jobskin (used in 71 units) produced the best results in controlling scarring and contractures. Nine units used rigid face masks and one unit used a combination of both masks plus an insert with only fair results. Duration of

pressure therapy ranged from a minimum of seven months to a maximum of 18 months. No comments were offered to explain the popularity of the elastic mask. Gallagher's[75] study further showed that there was no uniform technique for measurement which consistently provided excellent results.

As stated earlier, the choice of pressure mask depends on the anatomical location of the facial burn; patient's age; and therapist, patient, or burn unit preference. However, having several therapeutic options allows the therapist to individualize treatment to achieve the most desirable outcome for each patient.

Splinting

A burn contracture is defined as a burn wound that shortens until meeting an opposing force.[4] Splinting is used to exert the opposing force thus preventing or decreasing the incidence of contractures. A burn contracture is unique in that it can involve more than one joint. It is therefore necessary to not only stretch the affected joints but the entire scar tissue.[69]

Neck contractures are treated with sustained stretch via splinting or constant traction (halo). A static (resting) splint is preferred for prevention of contractures as it immobilizes the body part in a functional position.[76] An added benefit of a static splint is compression of the forming scar.[4,8,11,65,77] The splint should be worn at all times unless the patient experiences pain other than

stretching pain. Alternate sources of pain could result from sensory impairment or wound maceration; both sources would necessitate removal of the splint for alterations.[65] Prevention of unwarranted pressure may be alleviated with the use of adjustments or extra padding.

It is possible to wear splints over open wounds if proper cleansing agents are used. A quaternary ammonia (one fluid ounce/gallon water) is recommended as it is 100% effective in eliminating organisms found on splints. Wright's[77] study showed that 50% of splints carried organisms which could contaminate the open wound. The splints must be cleaned; drying done alone is ineffective in removing organisms.

A common usage for splinting of facially burned patients is for the prevention of microstomia. Microstomia is contraction of the soft tissues surrounding the mouth resulting in a narrowing of the oral aperture. It is a disfiguring complication causing difficulties in oral, dental, and TMJ health, increased psychological stress, impaired speech, impaired facial expression, and in the young - aberrant development of dental arches.[78,79] The TMJ can be restricted as contractures of the mouth prevent full TMJ range.[80] Microstomia can further complicate grafting and reconstructive surgeries by making general anesthetic procedures hazardous by complicating endotracheal intubation.[79,80]

Microstomial splint usage begins as soon as edema recedes.[11,81] It is recommended that microstomial splints be worn continually with the exception of eating, conversation, and when receiving oral care.[11,81,82] The splint is worn until the scar matures. Heinle[82] reports 97% satisfactory results at a one year follow up on patients demonstrating compliance with usage of microstomial devices.

Static microstomial splinting begins in the acute stage and generally involves readily available splints such as the microstomial prevention appliance (MPA) also known as the Hartford device.[17,81] The MPA is an extraoral device consisting of two clear acrylic sections separated by adjustable stainless-steel bars with a thumbscrew closure. The acrylic sections fit into the commissures of the mouth. The splint comes in small, large, and extra large to accommodate both child and adult mouths with a range of expansion from 3.8 to 9.0 centimeter (cm).[12,81] Adjustments in expansion can be made at two millimeter (mm) increments as the patient's ROM increases.

Advantages of the MPA include easy insertion and cleaning of the device by patient or family member. MPAs are also inexpensive and result in a decreased incidence of reconstructive surgeries.[82] Disadvantages of the MPA include ulceration at the oral commissures due to excessive pressure on the viable tissue.[83] Patients complain of an inability to retain oral secretions as the MPA keeps the

lips apart resulting in xerostomia and drooling. Extraoral devices are also large, bulky, and affect acts-of-daily-living (ADLs) resulting in noncompliance.[78,79]

MacMillan[84] designed an intraoral microstomial device which is recommended when the patient's oral commissures have ulcerated. This device is custom made by inserting a stock impression tray into the oral cavity. The mold is then used to construct upper and lower dental arches made of polyvinyl. MacMillan recommends wearing the device continually for two days followed by usage during sleep and for two two-hour periods during the day until scar maturation.

Advantages of an intraoral device include easy removal for cleaning, simple modification as ROM increases, elimination of ulceration, and decreased patient complaints of xerostomia resulting in increased patient compliance. As with all microstomial devices, decreased incidence of reconstructive surgeries is also an advantage. Disadvantages include cost and availability.[84]

A Molt Mouth Prop (A.V. Mueller, Chicago, IL) is used to maintain or increase the mouth opening. This microstomial device functions to assist the patient with additional opening of the mouth by 20 to 25 mm. Recommended usage is several times per day for five minute intervals.[80]

To maintain a mouth opening or while waiting for a specific microstomial device, the therapist can prevent

microstomia by using tongue blades. The therapist places as many tongue blades between the patient's teeth as possible until a moderate resistance is noted. This is the initial baseline. Additional tongue blades are gradually placed in the patient's mouth at further treatment sessions until a maximum of 15 to 20 is reached. The patient should retain the blades in her or his mouth for intervals of 5 minutes, several times per day. Tongue blades are economical, readily available, and their usage is easy to teach to patients or family members.[80]

Exercise

Exercise improves mobility, strength, and function thereby preventing lasting deformity due to burn scar formation. Immobilization can result in scar contracture, muscle atrophy,[54,55,85-87] deleterious effects on articular cartilage,[85,86] decreases in joint ROM,[54,44,87,88] pain,[54,55,87,88] respiratory complications,[54,55,87,88] and a possible decrease in the strength of bones.[85,86] Exercise is necessary to prevent contractures even though a patient utilizes splints, as contractures can form even if a patient is continually splinted in the same position.

Exercise is difficult for patients due to edema, pain, loss of skin elasticity, and joint stiffness.[89] The patient's age, past and present medical history, and mental status need be considered when designing an exercise program. Exercise sessions generally occur two to three

times per day.[11] Following grafting, care must be taken not to damage newly formed fragile skin with an overly aggressive exercise program. Exercise is discontinued until the graft "takes".

Patients exhibiting dyspnea, diaphoresis, increased respiration, tachycardia, and an immediate increase of more than 20 mmHg systolic blood pressure are intolerant to the exercise session. Caution is advised and the exercises should be stopped or decreased.[90]

It is important to encourage patients to perform functional exercise through independent ADLs. This will increase their self-esteem and decrease their dependence on the burn staff. Family members should participate in the formal exercise sessions to become familiar with the program. Self-exercising by the patient is then possible with the family members providing encouragement and motivation.[11]

Motivating the patient to exercise through pain is necessary and difficult as the patient may be unable to follow directions due to pain medications. Many patients experience a temporary relief from pain and stiffness following an exercise session. This comfort can be used as future motivation. Meeting patients who have undergone an exercise program may also assist in motivating a hesitant patient and in educating them on the importance of stretching the new skin.[8]

Stretching is effective in lengthening the scar tissue and increasing joint motion. An appropriate stretch is indicated by blanching of the scar.[62] Passive stretching of the lips and cheeks involves inserting a Toothette swab (Halbrand, Inc., Willoughby, OH) into the mouth and stretching from inside the oral cavity.[80] Puffing the cheeks out followed by sucking the cheeks in provides sufficient active stretching.[12] Facial expressions of sneering, smiling, and grimacing with eyelids held tightly shut will stretch the skin from the eyelids to the mouth. Stretching the forehead involves performing expressions of mood such as surprise, frowning, and distaste.[12]

Facial exercises prevent contractures and assist with softening the scar tissue.[83] Active range of motion (AROM) reduces edema, maintains or regains previous range of motion, and increases strength. Facial AROM exercises consist of gradually stretching the mouth and TMJ open, followed by retraction of the corners of the mouth and puckering of the lips.[80] Patients are encouraged to open and close the mouth as wide as possible and to perform lateral jaw movements.[91,92] Chewing gum with exaggerated movements, again focusing on wide opening of the mouth and lateral movement of the jaw is advised.[91,92] AROM for the mandible includes protraction, retraction, and lateral movements.[12,87,88]

The patient is encouraged to wrinkle and move the muscles of the eyes, forehead, nose, cheeks, and neck.[80] The eyelids should be closed tightly and held closed several times each hour.[12]

Initially, the facial movement is entirely AROM as the wounds are open and painful.[80] Active assisted range of motion (AAROM) may be used prior to AROM. It is initiated once the edema recedes and the wound has begun to heal. The patient begins the movement and the therapist applies pressure in the direction of the muscle contraction. The amount of pressure applied depends on patient's tolerance.[80] The patient progresses to AROM.

Passive range of motion (PROM) is performed if the patient is unable to acquire the full range of motion with AROM, when it is not recommended for the patient to move on their own,[8] or when the patient is comatose or uncooperative.[46,80] PROM is beneficial in maintaining available ROM. Williams[80] recommends using an antibiotic ointment or cocoa butter to serve as a lubricant for stretching the skin without tears. PROM occurs only in patients whose grafts are secure.

CHAPTER 6

PSYCHOLOGICAL HEALING

Initially upon sustaining a burn the patient is most concerned with survival. Once the patient is assured they will survive, it is necessary for her or him to retain a sense of hope for the future. Without hope, the patient experiences a damaged self image and may undergo depression. There is a sense of failure, an inability to cope, and a lack of satisfaction from interpersonal relationships.[93]

Unfortunately, many facially burned patients withdraw from the world and dissolve previously formed social ties, which MacGregor[94] refers to as "social death". If the patient is unable to deal with the long term effects of the burn injury she or he may become a societal dropout, recluse, or substance abuser.[95] Each patient must find a sense of self-worth and value as part of their rehabilitation.[96]

This chapter will look at the long-term ability of patients to cope with changes imposed upon them by their burns. Specifically, this chapter will discuss psychological responses, predictors for patients likely to require psychological therapy, stigmatism, post-traumatic

stress disorder and organic brain syndrome, and the effects of pain on psychological healing.

Psychological Responses

The burned patient generally goes through several predictable psychological responses in the acute stage. These responses are anxiety, denial, depression, grief and mourning.[95,97]

Anxiety

Anxiety begins at the time of injury when the patient is concerned with survival and pain.[98] Anxiety makes the patient feel vulnerable and mortal; these feelings may endure long after the outward burns have healed.[95] Anxiety may result from being separated from home and loved ones and is especially marked in children.[99] Symptoms of anxiety include startle responses, difficulty in following instructions or concentrating, withdrawal, noncompliance, and inappropriate behavior.[100] Anxiety may be reduced by speaking to the patient in a calm and soothing voice, allowing the patient to verbalize her or his fears, frequent orientations, and by explaining painful procedures before performing them.[100]

Denial

A second response is denial. Denial distorts reality; unrealistic expectations post discharge may result in poor psychological adjustment.[95] Denial may be noted as the patient expresses unrealistic goals and underestimates the

seriousness of her or his injuries. Denial signals a need for psychological intervention.[101]

Depression

Depression is due to a loss of health, loss of appearance, and loss of ability to function as compared to pre-injury levels.[95,98] The patient may feel separated from her or his previous life and dread social reintegration.[95,102] Guilt may be experienced over forced dependency on others.[98,100] Guilt is also a response to the burn injury regardless of whether or not the patient was responsible for the burns.[95,96,102] Guilt may be so intense that the patient feels the injury is a punishment for past sins.

Depression may resolve as the patient heals outwardly or intensify as the patient becomes increasingly aware of what she or he has lost.[95,100] Unresolved depression can lead to suicidal thoughts or attempts.[99] Children tend to withdraw when depressed.[13] Females tend to experience more severe depression than males.[103] Both females and males may feel they are no longer feminine or masculine.[95] Unfortunately, severe depression may initially go untreated due to the more urgent needs of survival and tending to the burn wound.[99]

Grief and Mourning

Grief and mourning result from loss of an extremity, or body image. Grief and mourning may extend beyond the individual patient if a loved one or even a stranger died as

a result of the accident. Grief may be due to the loss of one's home, property, or other financial loss.[95,100]

Predictors for Patients Benefitting from Psychological Therapy

Many patients may experience unsatisfactory postburn adjustment which may interfere with their rehabilitation therapy. Factors which predict adjustment difficulty include the extent of the burn,[103-105] lack of social support,[106] history of psychiatric problems,[107] substance abuse,[105] or a recent major life change prior to the injury.[104] Gender also plays a role in postburn adjustment. Females tend to experience lower self-esteem, increased problems with body image, and decreased sexual functioning as compared to males, regardless of the extent of the burn.[108]

There is no direct correlation between the extent of the burn and the psychological adjustment of the patient. Even patients with minor burns experience psychological problems, especially if burns to the face are involved.[98] At the very least, many patients will undergo anxiety, depression, family stress, and a lack of social support as a result of their burns. Most may benefit from psychotherapy.[109]

Numerous psychologic assessment tools are available to identify patients with psychological problems. The Psychological Adjustment to Illness Scale (PAIS) is a psychological screening test specific to patients with

burns. It takes approximately 15-60 minutes to administer. Early use of such a screening tool provides increased accuracy in predicting patients who may benefit from psychotherapy. All burn patients should be screened.[95] Those patients identified as having psychological problems can then undergo more extensive examination to maximize their long-term rehabilitation outcome.[98] Subsequent treatment may include individual, group, or family therapy. In cases where more intervention is necessary, psychopharmacologic treatment is given.[99,100]

Rehabilitation of facial burns is mostly influenced by social and psychological influences. The skilled therapist, therefore, must learn to recognize when the patient is in need of psychological intervention.[93] Since the treatment of a burn patient is a group approach aimed at treating the "whole" patient, therapists can assist by taking the time to listen to the patient to gain a knowledge of their culture, thoughts, emotions, and social and sexual background.[95,101] The end result of rehabilitation is the return of the patient as a functioning member of society with self respect and dignity.[95]

Stigmatism

The quality of life for a patient with facial burns depends on the patient's psychological responses to interactions with society. Unfortunately, society responds negatively towards individuals with burns.[95,96] Patients with

facial burns must learn to adapt to stressful situations involving the way others view their body and subsequent changes in intimate relations.[93]

We all judge ourselves in reference to our community and our community's reaction toward us.[110] The average person is confident that when they enter the community they will be accepted. Unfortunately, the burned individual is not afforded this confidence and must adapt coping strategies to maintain their sense of self-worth. An adult burn patient may adapt to a negative reaction easier than a child as the "core" of one's worth (or lack of it) is internalized during childhood and adolescence.[110] However, a person's sense of value can never become independent of the valuing of other people.[110] The individual with facial burns must learn to successfully cope with their altered body image and face the negative reaction, or stigmatism, of society for the remainder of their life.

Stigmatism does not allow disfigured individuals full social acceptance.[111] "Stigma" refers to body signs which call attention to the bearer in a negative way; others then avoid the bearer of the sign.[112] Unfortunately, burn patients experience stigmatism from employers, schools, friends, and even their own family members.[95] Stigmatism can be overcome with appropriate therapy, assistance from sympathetic family members, and by the development of coping strategies.[99]

Strategies for coping can be both negative and positive. Examples of negative strategies include withdrawal, substance abuse, and aggression.[95] Examples of positive strategies include cooperation, sociability, confidence, and forcefulness.[98] The patient's ability to cope is generally measured by observational factors such as return to work, substance abuse, or exacerbation of pre-existing psychological problems.[96]

Post-Traumatic Stress Disorder and Organic Brain Syndrome

Occasionally, the process of returning the healed burn patient to society is impaired by internal factors requiring more intense psychological intervention. Two such examples include post-traumatic stress disorder and organic brain syndrome.

Post-traumatic stress disorder (PTSD) can slow the progress of returning the patient to society as a functioning member of that society. The amount of social support available to a patient is a major variable in psychological adjustment.[113] Lack of adequate social support for the burn patient is strongly associated with increased occurrence of PTSD.[114]

The primary symptom of PTSD is a reliving of the experience through intrusive dreams, illusions, hallucinations, and flashbacks. Episodes occur without warning, resulting in an underlying increase in anxiety.[95,115] Dreams, illusions, hallucinations, and flashbacks are

expected following a traumatic experience. There is cause for concern only if these episodes continue once the patient has been discharged.[95] To be diagnosed with PTSD, the symptoms need be experienced at least one month beyond the traumatic incident.[98]

The second major psychological disorder to be discussed is organic brain syndrome. The patient may have incurred injuries beyond the external burn wound such as trauma to the brain and internal organs. Injuries which interfere with cerebral functioning lead to the diagnosis of organic brain syndrome.

Organic brain syndrome can occur secondary to smoke inhalation, metabolic changes, narcotics, or other factors not fully understood. The patient may experience a form of delirium due to the brain injury. The delirium may be temporary, as with narcotics, or it may last for weeks, months, or even permanently. The patient may experience memory deficits, disorientation, confusion, and undergo personality changes with labile moods. In extreme cases, patients may become psychotic and undergo hallucinations. whenever organic brain syndrome occurs, patients may present with reduced ability to participate in the rehabilitation program. The cause of the brain injury needs to be determined so a long term rehabilitation program can be planned around the limitations.[95]

Pain

Pain is a major concern for burn patients. Many patients claim they would rather die than endure the pain of rehabilitation from a second burn injury. Patients who experience pain will not make a maximum effort with exercise and repetitive movement even once the acute pain is controlled.[95] Patient's who are depressed will have less energy to tolerate pain.[116] Psychological problems are more likely to develop in patients experiencing problems with pain management than those with controlled pain.[117] Pain can be increased due to environmental factors such as noise and temperature, as well as weariness from continuous monitoring by the burn staff.[100] It is therefore necessary for patients to receive adequate pain relief before therapy sessions to ensure optimal results are achieved.[95]

It is not important which form of pain medication is utilized; it is important that the patient reports a subjective relief of pain. The goal of pain management is total relief of pain, although this is not always possible.[100] Concerns of drug addiction should not prevent the patient from receiving adequate narcotic doses for relief. The staff need also be prepared for the patient to develop a tolerance to the narcotic used. The patient will require increasingly larger doses to maintain an adequate degree of pain relief.[95] Once the patient is nearing discharge, the amount of narcotics received must be tapered

off and eventually eliminated. It is extremely rare for a burn patient to become an addict as a result of receiving narcotics for pain relief during rehabilitation, even if the patient has a previous history of substance abuse.[118] If a patient has experienced problems with alcohol and substance abuse premorbidly, psychological treatment and referral to an appropriate support organization such as Alcoholics Anonymous or Narcotics Anonymous is recommended. Family members in need of support should also be referred.[95]

Anxiety increases pain perception.[116] Pain and anxiety are positively correlated.[119] A reduction in anxiety is effective in reducing the patient's perception of pain.[120] A group approach where burned peers and staff members encourage the patient to endure the pain and limit her or his expressions of pain is recommended. Patients report the group effort reduces their anxiety and thus their pain.[121]

Medications are not always appropriate for pain relief. Forms of nonpharmacologic pain relief are considered for use with children and in patients with a history of addiction to reduce side effects associated with pain medications.[122] Nonpharmacologic forms of pain relief during the acute stages may be obtained from psychological techniques such as hypnosis, distraction, and relaxation.[95,116,122]

Hypnosis is the most frequently used form of psychological pain control. The high degree of pain burn patients experience makes them responsive hypnotic subjects;

hypnosis modifies the pain level.[118] Hypnosis has been well studied and continues to present with conflicting results. Hypnosis is effective in only a few patients when used independently, with an increase in effectiveness when used in conjunction with analgesics.[123] Unfortunately, there is no way to predict which patients may benefit from hypnotherapy.

Distraction therapy refocuses the patient's attention from pain toward pleasant sensory stimulus.[118,124] The patient is distracted with auditory and visual stimulation, with an eventual increase in pain tolerance.[125] Alternating materials and choosing tapes and videos of interest to the patient will prevent boredom.[126] Elliot and Olson[127] conducted a study using distraction with children and found a 25% to 52% pain reduction. Whereas Kelly[128] found that adults perceived a 40% reduction in pain using visual distraction. Distraction therapy is used in combination with analgesics to achieve optimal pain relief.[126]

Relaxation techniques focusing on breathing are performed by the patient before debridement or other anxiety producing procedures. Several studies have found that the patient's anxiety and pain are decreased; there is also a significant decrease in blood pressure and pulse.[129,130] Relaxation techniques are seldom used in burn centers, however, as the pain is too severe and lengthy and repeated sessions are too time consuming.[8,118]

Pain relief beyond the acute stage may also be achieved with the use of modalities such as transcutaneous electrical nerve stimulation (TENS) and ultrasound (US).[8,131] TENS electrodes should not be positioned for transcranial stimulation.[8] Ultrasound is effective in facilitating exercise, increasing circulation, separating the collagen fibers within the scar,[10] and softening the newly formed skin,[7,52,131] thus decreasing pain. Extreme caution should be used with these modalities on the face as skin sensitivity, hypesthesia, or skin breakdown could result from heat, electrode adhesive, or conducting medium.[8]

After discharge, the patient may continue to require pain relief. Before choosing a form of pain relief, it is necessary to determine the underlying cause of the pain and distinguish between emotional and/or physical pain. Depending on the source of the pain, relief may be in the form of psychotropic drugs, psychotherapy, or medication for chronic pain.[95]

CHAPTER 7

CONCLUSION

This paper has provided an overview of wound care for patients with thermal facial burns. Burn classification, grafting, wound care, skin care, deformity prevention, and psychological healing and pain control were discussed.

Physical therapists must be prepared to be flexible and creative in designing treatment to achieve the maximal functional and cosmetic outcomes. Physical therapists must also be informed on the psychosocial aspects of healing to ensure their patients receive adequate and timely psychological intervention. No one protocol is adequate for all burn patients. Choosing the optimal form of treatment may prevent postburn reconstructive surgery. Optimal treatment will also maximize the patient's return to society as an integrated functioning member of that society.

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